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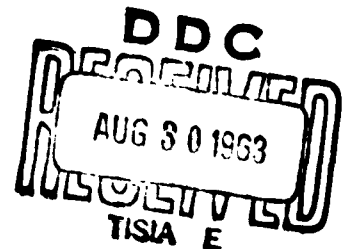
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# Prediction of Success in Technical Training From Self-Report Information on Educational Achievement

By  
Leland D. Brekaw

Technical Documentary Report PRL-TDR-63-11

April 1963



6570TH PERSONNEL RESEARCH LABORATORY  
AEROSPACE MEDICAL DIVISION  
AIR FORCE SYSTEMS COMMAND  
Lockland Air Force Base, Texas

Project 7717, Task 771705

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**PRL-TDR-63-11**

**PREDICTION OF SUCCESS IN TECHNICAL TRAINING FROM SELF-REPORT  
INFORMATION ON EDUCATIONAL ACHIEVEMENT**

**By  
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## **ABSTRACT**

Educational information about recruits was evaluated for its potential contribution to airman classification. A self-report biographical inventory provided 53 education variables from the responses to 16 questions. Multiple regression analysis for graduates from 8 technical schools (samples from 267 to 820) showed that prediction of technical school success improved significantly when education variables were combined with the aptitude index. The educational information is valid alone, as well as in combination with the aptitude measure, for use in airman selection.

This report has been reviewed and is approved.

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## PREDICTION OF SUCCESS IN TECHNICAL TRAINING FROM SELF-REPORT INFORMATION ON EDUCATIONAL ACHIEVEMENT

### 1. INTRODUCTION

The Air Force has used paper-and-pencil aptitude tests for the classification of enlisted personnel since 1948 (Dailey, Lecznar, & Brokaw, 1948). More recently aptitude tests have been used for the selective enlistment of Air Force personnel (Lecznar & Davydiuk, 1960). Such tests have shown consistent efficiency in the prediction of technical school grades (Brokaw, 1957, 1959a, 1959b). In addition to the aptitude measures, descriptive statements of years of education and age have been analyzed as variables in validation studies. The education-in-years variable has demonstrated consistent validity for the technical school criteria.

During the period 1948-1958 any direct use of educational information was avoided because of the demonstrated efficiency of aptitude tests in prediction of technical school grades, and to permit use of the widest possible manpower base to meet Air Force manning requirements.

More recently other criteria of Air Force success have become important. The matters of adaptability to Air Force life and personal reliability in the operation and maintenance of high-yield weapons have become issues for research. Flyer (1959, 1960) has examined these areas and has found educational level a predictor of desirable performance in both.

Information on exposure to high school courses, without data on achievement, has been demonstrated by Judy (1959a, 1959b) to be valid for prediction of assignment or of success on a mechanical job knowledge test. He found that the educational information would make no significant improvement in prediction beyond that provided by the aptitude scores or other variables.

He further investigated the relationships between a number of educational variables and success in technical training (Judy, 1960). He found that high school graduation was the best predictor of success, and that exposure to particular high school courses was also valid. Completion of individual courses did not make a significant contribution to the prediction of success when the effects of other information were controlled.

During the period of administration of the airman classification batteries, with particular reference to the AC-2A battery from January 1956 until August 1959, some information on the educational background and achievement of Air Force personnel was collected. These data were in the form of responses to biographical information items appearing in the battery (Brokaw, 1957). Piecemeal use had been made of this information, as isolated items appeared in the keys prepared for various aptitude areas.

Comprehensive analyses of these data are now possible. A study of the items of the biographical inventory grouped into homogeneous keys has demonstrated that educational items are significantly predictive of success in technical school (Brokaw, 1962).

### 2. PURPOSE

This study was initiated for two major purposes; first, to evaluate a system of classification for assignment to technical school using aptitude information and reasonably comprehensive information on educational level, experience, and achievement. Secondly, to determine whether a brief questionnaire devoted solely to educational topics would be of sufficient validity to permit its use in addition to the Airman Qualifying Examination by recruiting personnel in appraising a prospective enlistee as a desirable addition to the Air Force.

Educational information, in terms of numbers of years completed or in terms of a statement of high school graduation, was collected during the enlisted testing program and has provided data for Flyer's findings, cited above. The present study assesses the value of more specific educational information, in comparison with the gross statement of level or graduation information, as a predictor of technical school success.

### 3. THE DATA

This study is focussed on analyses of the items of the biographical inventory dealing with educational topics within a representative sample of Air Force technical schools. Sixteen questions covering educational background and achievement appeared in the inventory. The responses to these questions were used singly and in groups to provide a total of 53 variables for entry into multiple regression systems to determine their contribution to the prediction of technical school success. A listing of these variables appears as Appendix I.

These variables were used in the development of multiple regression equations for the prediction of success as reflected in the final course grade in eight technical schools. These eight schools included a pair of schools from each of the four aptitude clusters, selected as representative of the majority of Air Force schools. An attempt was made to include a school with relatively "high" aptitude requirements for entrance, and a school with "low" requirements from each cluster.

The data were collected from operational administration of the Airman Classification Battery during the period 1 January 1956 to 1 March 1957. This time was characterized by low aptitude means for Air Force recruits, so that the groups selected for analysis overlapped considerably in aptitude level on the selector index (Lecznar, 1962).

### 4. THE STUDY DESIGN

Analyses were performed using a total of 4,458 graduates from eight technical courses. The sample attending each course, and the statistics descriptive of the distribution of the selector aptitude index appear in Table 1.

*Table 1. Description of Samples*

Course Number	Title	Selector Aptitude Index			
		N	AI*	Mean	SD
AB43231	Reciprocating Engine Mechanic	738	M	63.81	18.05
AB46130	Munitions Specialist	690	M	52.51	15.67
AB64131	Organizational Supply Specialist	593	A	44.34	14.84
AB67130	Accounting and Finance Specialist	267	A	76.35	12.37
AB25231	Weather Observer	820	G	66.51	12.58
AB27231	Control Tower Operator	554	G	66.28	12.47
AB30130	Aircraft Radio Repairman	759	E	65.34	15.00
AB32230	Fire Control System Mechanic	433	E	59.53	14.65

\*M = Mechanical Aptitude Index  
A = Administrative Aptitude Index  
G = General Aptitude Index  
E = Electronic Aptitude Index



The variables for the initial phases of the study were based on the educational information derived from the biographical inventory. The first step of the analysis included the derivation of the correlation of each of the 53 educational variables of the biographical inventory, with the final school grade. These values appear in Appendix II.

The next step was the derivation of the multiple correlations of these 53 variables with the final course grades under three sets of conditions:

- (1) within the sample assigned to each technical course.
- (2) within the pair of courses falling under each of the four aptitude clusters.
- (3) with the graduates of all eight courses pooled into a single sample.

Composite scores developed from the resulting regression equations were then evaluated for their validity in each of the technical courses. The joint validity of the selector aptitude index and each of the composite scores was then established through derivation of a two-variable multiple correlation.

Unit weights were applied to 17 of the variables selected on the basis of high *B* weights derived in the regression system based upon all eight courses pooled. This composite score was similarly evaluated, as a check on the effectiveness of a brief scale for field use.

In addition to the composite score, the validity of high school graduation also was obtained for each of the eight courses, and evaluated in comparison with the composite scores for its potential addition to the predictive efficiency of the aptitude indexes.

## 5. RESULTS AND DISCUSSION

The correlations with final course grade of the educational composites, high school graduation, and the selector aptitude indexes are given in Table 2. The multiple correlations of the aptitude index and each of the educational measures are also presented in Table 2. These data show the increase in correlation that comes from the combination of the aptitude data and the educational information. Although some of the correlations of the combined variables are but little larger than the correlations of the variables taken singly, in every instance the increase is significant well beyond the .01 level. While significance is a function of the large samples in the analysis, the numbers of recruits the Air Force deals with are correspondingly large.

The 17 variables that were selected for evaluation as combined by unit weights appeared in three kinds of information—the length of schooling to which the individual had been exposed, the kind of high school course he took, and the kinds of high school courses in which his academic achievement was either superior or less distinguished. These variables contributed to technical school success in a very reasonable manner—high school graduates are more successful than men who leave school after grammar school; airmen who were superior students in mathematics, science, social science, and languages are superior students in technical school; students who take college preparatory or general courses are better technical school trainees than men with backgrounds in vocational training.

It must be noted that these data are "raw" in the sense that they are presented just as derived from the test results and school grades. There has been no attempt to correct for the selected nature of the samples. In some instances the samples are notably biased. For example, the 267 cases in the AF67130 course attained a mean selector aptitude index of 76.37 with a standard deviation of 12.37, and 88 percent of the group were high school graduates or better. The total sample of 4,458 included only 65 percent of high school graduates.

**Table 2. Correlations of Aptitude Indexes and Self-Report Education Variables  
With Final Grades in Technical Training**

(Samples: Varying numbers of technical school graduates tested on the Airman Classification Battery AC-2A between January 1956 and March 1957.)

Variable	N:	Technical School Course							
		43231	46130	64131	67130	25231	27231	30130	32230
		738	690	593	267	820	554	759	433
Selector Aptitude Index (AI)		.52	.35	.41	.27	.49	.41	.60	.41
High School Graduation		.32	.28	.31	.18	.23	.14	.32	.26
Educational Variable Composites:									
Specific to Course		.50	.44	.46	.57	.49	.37	.49	.45
Specific to AI		.48	.40	.42	.44	.48	.32	.46	.40
Based on All 8 Courses		.46	.36	.34	.37	.42	.30	.44	.33
Unit-weighted Composite		.41	.34	.24	.28	.41	.28	.39	.28
Combination of Selector AI and:									
High School Graduation		.57	.42	.47	.31	.51	.42	.62	.45
Specific to Course		.64	.51	.53	.59	.59	.48	.65	.53
Specific to AI		.62	.49	.52	.48	.59	.46	.64	.48
Based on All 8 Courses		.60	.46	.47	.42	.55	.45	.63	.45
Unit-weighted Composite		.59	.45	.43	.35	.55	.44	.62	.43

*Note.*—The increase in predictive efficiency coming from the combination of the aptitude index and the educational variables was evaluated by deriving the *F* coefficient. Both comparisons were made—the multiple correlation of the pair was evaluated against the validity of the aptitude index alone and against the validity of the various educational scores alone. Small numerical increases in correlation coefficients, in samples as large as these, produce highly significant improvements in predictive efficiency. Every comparison showed improvement well beyond the .01 level of significance. The actual *F* ratios and multiple correlation worksheets may be requested from the 6570th Personnel Research Laboratory (PRS), Lackland AFB, Tex.

Corrections for restriction of range have not been attempted because it is impossible to meet the assumptions basic to the conventional correction formulas. The distribution of educational level in the population available for Air Force service is unknown, and yet experience has shown it to be very different in 1963 from what it was in 1956 when these data were collected. It is recognized that the aptitude distributions are restricted in complex patterns. In addition to curtailment at the lower end from the application of minimum levels for service entry, there is erosion and truncation at the top from the skimming of the more talented airmen for entry into demanding electronics and general aptitude courses.

The data as derived are descriptive of the phenomena of the sample at hand, and the results are accepted as indicating basic relationships of the educational information and aptitude measures. Application of these measures in the current programs will require a reevaluation of these relationships in current examinee populations. The present study emphasizes the requirement for such analyses in the production of effective instruments for use in Air Force selection and classification programs.

## 6. SUMMARY

Regression analysis of aptitude measures, educational background, and achievement information collected from a self-report biographical inventory demonstrate that the educational information makes significant contribution to the prediction of technical school success.

The analyses revealed that the educational data could contribute significantly to the aptitude data if applied simultaneously in a prediction equation, or would provide an independent measure of useful validity if use as a prescreen were desired. Such prescreening would imply a severely favorable selection ratio, and the more effective use would be in combination with the aptitude measures.

Variation in educational qualification of potential Air Force recruits between the present and the time these data were collected in 1956 dictates a reevaluation of the discovered relationships for application in current programs.

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# APPENDIX I

## Variables Derived From Biographical Inventory Questions, Airman Classification Battery AC-2A, Dealing With Respondents' Education

Var No.	Paraphrase of Response Content	Var No.	Paraphrase of Response Content
1	Grade school or less	25	Superior science
2	Attended high school, did not graduate	26	Average science
3	High school graduate	27	Poor science
4	Attended college, did not graduate	28	Science not taken
5	College graduate	29	Average or better social science
6	Attended 1 or 2 grade and high schools	30	Social science not taken
7	Attended 3 or 4 grade and high schools	31	Average or better English
8	Attended 5 or 6 grade and high schools	32	English not taken
9	Attended 7 or 8 grade and high schools	33	Average or better foreign language
10	Attended more than 8 grade and high schools	34	Foreign language not taken
11	Less than 100 students in high school	35	Superior commercial courses
12	From 100 to 200 students in high school	36	Average commercial courses
13	From 200 to 1000 students in high school	37	Commercial courses not taken
14	From 1000 to 2000	38	Average or better music & art
15	More than 2000	39	Music and art not taken
16	Took trade course in high school	40	Average or better public speaking
17	Took agricultural course	41	Public speaking not taken
18	Took commercial course	42	Average or better Physical training
19	Took college preparatory course	43	Physical training not taken
20	Took general course	44	Average or better domestic science
		45	Domestic science not taken
	The following responses describe achieve- ment in high school courses:	46	Above average shopwork
21	Superior mathematics	47	Average shopwork
22	Average mathematics	48	Poor shopwork
23	Poor mathematics	49	Shopwork not taken
24	Mathematics not taken	50	Above average mechanical drawing
		51	Average mechanical drawing
		52	Poor mechanical drawing
		53	Mechanical drawing not taken

# APPENDIX II

## Correlation of Educational Background Variables with Final School Grade in Eight Technical Training Courses

Var No.	Technical School Course							
	43231 N = 738	46130 N = 690	64131 N = 593	67130 N = 267	25231 N = 820	27231 N = 554	30130 N = 759	32230 N = 433
1	-04	-10	-09	00	-04	06	-06	-05
2	-30	-22	-28	-19	-22	-14	-31	-25
3	23	24	26	01	00	01	15	12
4	18	12	08	14	21	12	17	18
5	09	00	12	03	10	05	06	11
6	01	03	02	-11	03	-02	-09	00
7	03	-03	-03	08	-04	-01	09	06
8	01	06	04	06	01	01	00	00
9	-04	00	05	04	-04	03	04	01
10	-05	-04	-07	-13	04	03	-07	-15
11	03	-01	01	20	03	02	04	06
12	-01	-05	04	-05	04	02	-06	-08
13	02	02	05	04	01	-01	02	02
14	-02	10	04	-08	-01	-03	-01	02
15	04	01	-10	00	-04	03	04	02
16	-09	-06	-02	-07	-13	-09	-05	-09
17	-12	-08	00	-11	-04	-05	-16	-07
18	-05	08	09	11	-08	-05	-05	-01
19	16	17	08	15	21	21	24	15
20	10	07	-03	-20	-03	-09	-08	-01
21	22	19	12	30	28	13	20	06
22	-02	-01	-02	-24	-22	-09	-14	-02
23	-17	-06	-05	-13	-12	-06	-10	-06
24	-08	-06	-03	-02	00	-05	-03	06
25	19	16	06	09	19	13	21	17
26	-03	-02	01	-06	-12	-11	-12	-08
27	-14	-05	-02	-11	-06	-02	-09	-07
28	-01	03	-01	08	-05	00	-09	-06
29	17	20	17	08	09	05	16	04
30	-11	-09	-08	-03	-05	-05	-05	-06
31	14	18	17	09	14	08	11	15
32	-10	-06	-10	-10	-01	-11	-10	01
33	11	13	12	05	21	13	09	12
34	-04	-03	-04	-04	-16	-13	-05	-07
35	06	11	18	13	10	02	02	-01
36	02	06	10	-13	-09	-07	02	-04
37	02	-03	-17	00	01	05	01	08
38	-04	01	00	-10	-02	01	-01	04
39	08	06	08	13	03	00	05	01
40	-05	-03	-03	-03	-03	00	03	-03
41	08	01	03	01	04	02	-02	04
42	07	16	13	-07	00	-02	08	01
43	02	-06	-04	00	02	04	-02	06
44	-08	-04	-06	-10	-03	-06	01	-05
45	14	14	15	09	06	07	04	08
46	03	05	-04	00	-02	-07	06	05
47	-05	03	03	00	-05	00	-09	-15
48	-03	-04	00	-01	-04	04	-08	-10
49	09	04	07	00	09	07	06	13
50	13	14	09	03	03	06	20	03
51	-04	-01	-02	-07	-08	-04	-09	-05
52	-03	-05	-02	-06	-07	-01	-01	-06
53	-03	01	02	06	06	-01	-09	05

Note.—Decimal points omitted. For variable identification see Appendix I.

<p>6570th Personnel Research Laboratory, Aerospace Medical Division, Lackland AF Base, Tex. Rpt No. PRL-TDR-63-11. PREDICTION OF SUCCESS IN TECHNICAL TRAINING FROM SELF-REPORT INFORMATION ON EDUCATIONAL ACHIEVEMENT. Apr 63, iii + 8 p. incl tables, 12 refs.  Unclassified Report</p> <p>Educational information about recruits was evaluated for its potential contribution to airman classification. A self-report biographical inventory provided 53 education variables from the responses to 16 questions. Multiple regression analysis for graduates from 8 technical schools (samples from 267 to 820) showed that prediction of technical school success improved significantly when education variables were combined</p>	<ol style="list-style-type: none"><li>1 Military personnel</li><li>2 Education</li><li>3 Statistical analysis</li><li>4 Mathematical prediction</li><li>5 Military training</li><li>6 Psychometrics</li><li>7 Aptitude tests</li><li>8 Correlation techniques</li><li>9 Selection</li></ol> <ol style="list-style-type: none"><li>I AFSC Project (Task) 7717(05)</li><li>II L.D. Brokaw</li><li>III Aval &amp; OTS</li><li>IV In ASTIA collection</li></ol>
<p>with the aptitude index. The educational information is valid alone, as well as in combination with the aptitude measure, for use in airman selection.</p> <p>SMA 1517</p>	

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